Use of Paravertebral Block Anesthesia in the Surgical Management of Breast Cancer

Experience in 156 Cases

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Objective

To assess safety and efficacy of the regional anesthetic technique paravertebral block for operative treatment of breast cancer, and to compare postoperative pain, nausea, vomiting, and length of hospital stay in patients undergoing breast surgery using paravertebral block and general anesthesia.

Background

General anesthesia is currently the standard technique used for surgical treatment of breast cancer. Increasing hospital costs have focused attention on reducing the length of hospital stay for these patients. However, the side effects and complications of general anesthesia preclude ambulatory surgery for most patients undergoing breast surgery. In April 1994, the authors initiated the use of paravertebral block anesthesia for patients undergoing primary breast cancer surgery. A review of our early experience revealed that this regional anesthetic technique enables effective anesthesia for operative procedures of the breast and axilla, reduces postoperative nausea and vomiting, and provides prolonged postoperative sensory block that minimizes narcotic requirements.

Methods

A retrospective analysis of 145 consecutive patients undergoing 156 breast cancer operations using paravertebral block and 100 patients undergoing general anesthesia during a 2-year period was performed. Anesthetic effectiveness and complications, inpatient experience with postoperative pain, nausea, vomiting, and length of stay were measured.

Results

Surgery was successfully completed in 85% of the cases attempted by using paravertebral block alone, and in 91% of the cases, surgery was completed by using paravertebral block supplemented with local anesthetic. There was a 2.6% incidence of complications associated with block placement. Twenty percent of patients in the paravertebral group required medication for nausea and vomiting during their hospital stay compared with 39% in the general anesthesia group. Narcotic analgesia was required in 98% of general anesthesia patients, as opposed to 25% of patients undergoing paravertebral block. Ninety-six percent of patients having paravertebral block anesthesia were discharged within the day of surgery, compared with 76% of patients who had a general anesthetic.

Conclusions

Paravertebral block can be used to perform major operations for breast cancer with minimal complications and a low rate of conversion to general anesthesia. Paravertebral block markedly improves the quality of recovery after breast cancer surgery and provides the patient with the option of ambulatory discharge.

An estimated 184,000 women were diagnosed with breast cancer in the United States in 1996.[1] After diagnostic confirmation, the vast majority of these patients underwent definitive surgery, most commonly modified radical mastectomy or lumpectomy with axillary dissection.[2] These surgical procedures are typically performed using general anesthesia followed by inpatient hospitalization. The large number of patients hospitalized annually for surgical management of breast cancer has focused efforts at containing hospital costs and reducing the length of hospital stay.[3-6] Early postoperative discharge of patients with closed-suction catheters in place was established in the 1980's as safe, well tolerated, and has resulted in significant cost savings.[3-6] This now represents routine surgical practice in the

United States. Performing breast cancer surgery on an ambulatory basis, however, is limited and rendered inappropriate because of postoperative nausea, vomiting, and incisional pain, which are all issues related more to the anesthetic, as opposed to the operative experience.

Nausea and vomiting complicate between 20% to 50% of all operative procedures.[7] The incidence is greater in patients undergoing general anesthesia, in female patients, in patients experiencing postoperative pain, and in women undergoing breast surgery.[7–11] A 59% incidence of nausea and vomiting during the 24-hour interval after breast cancer surgery with general anesthesia has been reported.[9] This complication prolongs recovery room stays and necessitates hospitalization for patients otherwise able to undergo ambulatory surgery.[7,8,11] Most importantly, nausea and vomiting have been described by patients as more debilitating than the operative procedure itself.[10] In addition, general anesthesia cannot achieve postoperative pain control. Parenteral narcotic use is routine after emergence from anesthesia and during the early postoperative interval, which further increases the incidence of nausea, vomiting, sedation, and results in prolonged recovery room and hospital stays.

Regional anesthesia using paravertebral block is an ideal alternative to general anesthesia for breast cancer surgery.[12] Benefits include a reduction in postoperative nausea and vomiting, prolonged postoperative pain relief, and potential for ambulatory discharge. Thoracic paravertebral block involves injection of local anesthetic at the site where the spinal nerve emerges from the intervertebral foramina. The paravertebral space contains dorsal and ventral rami and the sympathetic chain. Hence, infiltration of this space results in unilateral sensory, motor, and sympathetic blockade. Paravertebral block has been used to relieve acute chest wall pain from rib fractures, herpes zoster, and pleurisy,[13] to manage acute and chronic postthoracotomy pain,[14,15] and as an anesthetic technique for surgery of the chest and shoulder.[16] Recently, the initial experience at Duke University Medical Center with paravertebral block for the surgical management of breast cancer patients has been described, and benefits related to pain, nausea, vomiting, and length of stay were demonstrated.[17,18] Paravertebral block has been practiced at our institution since April 1994 and is now employed routinely. We report here our 2-year experience using this technique compared with the concurrent experience with general anesthesia, focusing specifically on anesthetic effectiveness and complications, postoperative analgesia, nausea, vomiting, and hospital stay.

METHODS

The inpatient hospital records of all patients under the care of three surgeons who underwent major breast surgical procedures under either general anesthesia or paravertebral block at Duke University Medical Center were reviewed. Patients undergoing cancer resection either under local an-

esthesia or with immediate breast reconstruction were excluded. Between April 1994 and April 1996, paravertebral block was employed in 156 procedures performed on 145 patients, while general anesthesia was employed in 100 cases performed on the same number of patients. The anesthetic technique used in an individual patient most commonly reflects 1) a trend on the part of the surgeons during this 2-year interval toward increasing preference for and recommendation to patients of paravertebral block 2) availability of anesthesiologists to perform the blocks as increasing numbers learned the technique 3) patient preference and 4) the rare instance of a contraindication to paravertebral block, either coagulopathy, infection at the injection site, or central neuropathy. All patients were women. Patients were scheduled to undergo surgery either on an ambulatory basis or were scheduled to be admitted overnight to a postoperative observation room. This decision was based on anticipation of patient needs after the chosen anesthetic and patient preference, which typically reflected factors such as travel distance from the hospital or availability of help at home.

Patients arrived on the day of surgery. Paravertebral block was performed in a monitored preoperative holding area by an attending anesthesiologist. The patients were either seated or prone for placement of the block and were sedated with incremental intravenous doses of midazolam (1–3 mg) and fentanyl (50–150 μg). Thoracic paravertebral blocks were then performed as described by Moore[19] and Katz.[20] Intradermal lidocaine was used at the site of the needle insertion. The superior aspect of the spinous processes of C7 - T6 were marked. The skin entry points were 3-cm lateral to the marks. A 22-gauge Quincke spinal needle attached through extension tubing to a syringe containing local anesthetic was used. The needle was inserted perpendicular to the skin at a distance of 2 to 4 cm until the transverse process was contacted. The needle was withdrawn and walked caudad off the transverse process and advanced a further 1.5 to 2 cm. After aspiration, 3 to 4 mL of bupivicaine 0.5% with 1:400,000 freshly added epinephrine was administered per level. Time for performance of blocks ranged from 10 to 15 minutes. The onset of sensory loss typically occurred 10 minutes after injection with surgical anesthesia ensuing 20 to 30 minutes after the injection. The patients were then transferred to the operating room. Intraoperative sedation was provided by titrated doses of diprivan (20 - 50μg/kg/minute) and patients were arousable on command. Intermittent doses of fentanyl (25μg) were used as needed. Patients having general anesthesia with endotracheal intubation underwent induction with diprivan, fentanyl, and succinylcholine. General anesthesia was maintained with nitrous oxide, isoflurane agents, and fentanyl infusion.

Mastectomy was performed through transverse or oblique incision, skin flaps were created using electrocautery, and the breast and pectoral fascia were excised from the chest wall. Axillary dissection as an independent procedure was

Table 1. OPERATIONS PERFORMED UNDER PARAVERTEBRAL BLOCK AND GENERAL ANESTHESIA

Procedures	Paravertebral Block	General Anesthesia
Modified radical mastectomy	75	56
Simple mastectomy	18	5
Wide local excision & axillary dissection	48	28
Axillary dissection alone	10	1
Wide local excision	3	7
Bilateral procedures	2	3
Total procedures	156	100

performed through an incision extending from the pectoralis muscle border to the latissimus dorsi. Level I and II nodes were included in the dissections. Mastectomy wounds were drained using two closed suction catheters (10 mm round Blake, Johnson & Johnson Medical., Arlington, TX), one placed in the axilla and one beneath the mastectomy skin flaps. Separate axillary wounds were drained through a single catheter. All operative specimens were submitted for permanent pathologic analysis. In selected cases, frozen section analysis was used to assess margins of resection.

After surgery, patients undergoing paravertebral block were transferred either to the recovery room or directly to an overnight stay room if sedation were adequately reversed. All patients undergoing general anesthesia were brought to the recovery room. Patients scheduled for ambulatory surgery were assessed in the recovery room with regard to suitability for same day discharge; they were either discharged from that location or held overnight as required. Provision of pain medication was based on assessment of patient need in each case, and all narcotic use was documented. With initiation of solid food intake, patients undergoing paravertebral block were prescribed Naprosyn (500 mg twice daily) as a standing order for 4 days. Postoperative nausea and vomiting were treated with intravenous or intramuscular antiemetics, and the use of these medications was also documented. Patients were discharged when they were able to tolerate oral intake and when adequate pain control on oral analgesia had been achieved. All patients were given written documentation and were instructed regarding home care of drains and wounds and expected drain output during their preoperative clinic visits. These instructions were reviewed before discharge.

Patient data recorded included age, American Society of Anesthesiologists' grade, operative procedure, type of anesthesia, anesthetic complications, inpatient narcotic and antiemetic use, and duration of hospital stay. Statistical analysis was performed using the Fisher's Exact test, Chi Square test, and Mann Whitney U test where appropriate. Data is presented as mean ± standard error of the mean unless otherwise indicated.

RESULTS

Table 1 illustrates the number of patients who underwent each operation in the two anesthetic categories. There was no significant difference in the number of axillary dissections performed with each anesthetic method studied (86.5% vs. 88%, p = 0.35) The mean age of patients undergoing paravertebral block and general anesthesia was 54.2 ± 1.0 years and 56.6 ± 1.6 years, respectively (p = 0.37). No difference between the groups in the mean operative time for modified radical mastectomy (117 ± 3.7 min. vs. 124 ± 5 min., p = 0.4) and for wide local excision with axillary dissection (123 ± 4.3 min. vs. 115 ± 5 min., p = 0.36) was noted. Similarly, there was no difference between groups in the mean operative blood loss for modified radical mastectomy (92 ± 8.4 mLs vs. 95 ± 8.4 , p = 0.56) and for wide local excision with axillary dissection (81.7 ± 9.3 mLs vs. 77.2 ± 7.6, p = 0.54). Statistical analysis revealed no significant difference in American Society of Anesthesiologists' grades for each anesthetic group (data not shown).

One hundred and thirty three (85.3%) of the surgical operations initiated using paravertebral block alone were completed without anesthetic supplementation or change of plan. In the remaining 23 cases (14.7%) some form of supplemental anesthesia was required. Nine patients (5.7%) required supplemental intraoperative local anesthetic alone (lidocaine 1%) to complement the paravertebral block. Nine percent of patients were deemed to have failed paravertebral block anesthesia and required general anesthesia. Seven patients (4.5%) with inadequate paravertebral block who were administered supplemental local anesthetic obtained insufficient anesthesia and were given nitrous oxide through a laryngeal mask. A further seven patients (4.5%) were deemed to have failed paravertebral block and were immediately given nitrous oxide through a laryngeal mask. Two of these seven patients were intubated in the course of inhalational anesthesia.

Table 2 illustrates the complications encountered with paravertebral block administration. Complications were noted in four cases, which represents 2.6% of paravertebral block procedures. Epidural extension was noted in two cases. One patient described paresthesia and numbness in both legs while in the recovery room. This resolved spontaneously. Another patient complained of arm paresthesia and shortness of breath perioperatively. This patient was intubated and the operation was completed under general

Table 2. COMPLICATIONS OF PARAVERTEBRAL BLOCK ADMINISTRATION

Epidural involvement	2
Epinephrine absorption	1
Pneumothorax	1
Total	4 (2.6%)

Table 3. HOSPITAL STAY IN PATIENTS UNDERGOING PARAVERTEBRAL BLOCK AND GENERAL ANESTHESIA

Hospital Stay	Paravertebral Block (%)	General Anesthesia (%)
Discharge from recovery room	44 (28.2)	11 (11)
Overnight stay <24 hours	106 (67.9)	65 (65)
Overnight stay >24 hours	6 (3.8)	24 (24)

anesthesia. One patient demonstrated evidence of epinephrine absorption, which responded to labetolol administration. One patient complained of severe chest and shoulder pain immediately after the operation. A chest x-ray revealed a small (15%) pneumothorax. The patient was given analgesia and the pneumothorax was managed conservatively without tube thoracostomy insertion.

Table 3 summarizes the length of hospital stay for all operations performed in each group. Use of paravertebral block resulted in a significantly shorter hospital stay (p < 0.0001) than general anesthesia for all operations. Forty four of the patients undergoing paravertebral block anesthesia (28.2%) were discharged on the day of surgery compared to 11% of the patients undergoing a general anesthetic. In total, 3.8% of patients having a paravertebral block remained in the hospital >24 hours compared with 24% of patients undergoing a general anesthetic. Patients who received a paravertebral block for modified radical mastectomy were discharged from the hospital earlier than those who received general anesthesia (Table 3) (p < 0.0001). Similarly, patients undergoing a wide local excision and axillary dissection under paravertebral block were discharged from the hospital earlier than those who received general anesthesia (p = 0.0002).

Because only inpatient data was collected, patients discharged on the day of the surgery were excluded from analysis of postoperative pain, nausea, and vomiting (Table 4). Only 14 of 112 patients (12.5%) required immediate postoperative analgesia or analgesia administration within 30 minutes of surgery after paravertebral block as compared with 72 of 89 patients (80.9%) who were given general anesthesia (p < 0.0001). Twenty-eight patients (25%) undergoing paravertebral block required some form of narcotic analgesic after paravertebral block as compared with 87 patients (97.8%) after general anesthesia. For all operative procedures, 23 of 112 patients (20.5%) in the paravertebral block group experienced nausea and vomiting that required antiemetic medication *versus* 35 patients (39.3%) after general anesthesia (p = 0.03). When the recovery room experience of the ambulatory patients is included, 24 of 156 patients (15.4%) in the paravertebral block group experienced postoperative nausea and vomiting *versus* 40 patients (40%) after general anesthesia (p < 0.0001).

Six attending anesthesiologists performed the paravertebral block placements in this study. Each individual placed

Table 4. POSTOPERATIVE PAIN AND NAUSEA/VOMITING—INPATIENT EXPERIENCE

Inpatients	Paravertebral Block (%)	General Anesthesia (%)
Number of nonambulatory patients	112	89
Patients requiring immediate postoperative analgesia	14 (12.5)	72 (80.9)
Patients requiring narcotic analgesia	28 (25)	87 (97.8)
Patients requiring antiemetic medication	23 (20.5)	35 (39.3)

between 8 and 78 blocks, with a success rate ranging from 75% to 90% (Table 5).

DISCUSSION

Paravertebral block can be performed successfully and with minimal complication in patients undergoing operative treatment for breast cancer. Patients undergoing surgery using this technique were less likely to experience nausea or vomiting during the immediate postoperative interval than patients having a general anesthetic. They also were less likely to require narcotic analgesia in the early postoperative period. This group of patients were collectively discharged significantly earlier than patients undergoing general anesthesia.

Paravertebral block provided adequate anesthesia for surgery of the breast and axilla in 85% of cases without any anesthetic supplementation and in 91% of cases without recourse to general anesthesia. These figures compare favorably with previous reports on paravertebral block use[21,22] and with other regional anesthetic procedures.[23-27] Block failure (9%) in each case was because of technical difficulty in defining the paravertebral space. A recent study of the use of thoracic epidural anesthesia for breast cancer

Table 5. PARAVERTEBRAL BLOCK SUCCESS RATES FOR INDIVIDUAL ANESTHESIOLOGISTS

Anesthesiologist	Number Blocks Placed	Number Blocks Successful*	Success %
A	78	70	90
B	31	24	77
C	21	18	86
D	10	8	80
E	8	7	88
F	8	6	75

* Success defined as block not requiring any supplemental anesthesia, including local.

surgery reported a technical failure rate of 26%.[28] The authors suggested that technical outcome was operator dependent with success rates ranging from 50% to 95%, reflecting the anesthesiologist's experience with the technique. By contrast, efficacy of paravertebral block in our experience does not appear to be operator dependent. Success rates ranged from 75% to 90% regardless of the number of procedures performed. This finding is consistent with the observation that thoracic paravertebral block is a relatively easy technique to learn.[12]

The low complication rate (2.6%) associated with the use of paravertebral block in our study is similar to recently reported large series of paravertebral block use.[12,15,22] Only two patients (1.3%) experienced evidence of epidural extension. This clinical finding is consistent with the experimental observation of minimal spread of radiologic contrast into the epidural space after paravertebral space injection.[12] Of note, two patients in our series underwent bilateral paravertebral blocks and neither experienced epidural spread. Only one patient experienced a clinical pneumothorax and this resolved spontaneously. One patient experienced evidence of epinephrine absorption. While there were no seizures in this series, Lonnquist et al.[22] reported a transient seizure in a patient given a rapid injection of bupivicaine without adrenaline. This observation emphasizes the need to use adrenaline with bupivicaine in all instances, both to reduce systemic absorption and to warn of potential local anesthetic toxicity.

A variety of local and regional anesthetic procedures for breast surgery have been described with the goals of avoiding problems encountered with general anesthesia and to reduce the postoperative hospital stay. These include local anesthetic infiltration,[29,30] field block,[31,32] intercostal nerve blocks,[23–25] brachial plexus blocks,[26] and thoracic epidural anesthesia.[27,28] While these procedures are more conducive to ambulatory surgery than general anesthesia, individual techniques have inherent deficiencies that are largely overcome by paravertebral block. Use of field block and local anesthetic infiltration produce pain with injection, tissue distortion, and the risk of local anesthetic toxicity.[23,24,27] During placement of intercostal nerve blocks, the scapula interferes with the injection of levels T1 and T2 at the midaxillary line,[33] which impairs effective axillary anesthesia, and hence the ability to perform regional nodal dissection. The lower cervical and upper thoracic levels are accessible in placing the paravertebral block. Hence, effective axillary anesthesia is achieved and there is no limitation to the operative treatment of breast cancer using this technique. While thoracic epidural anesthesia provides adequate intraoperative anesthesia, rapid absorption within the epidural space necessitates catheter maintenance with ongoing infusion to achieve prolonged postoperative pain relief. This requires close postoperative monitoring, limits mobilization, and can preclude ambulatory discharge because of the need for parenteral narcotic. The relative containment of the paravertebral space limits anesthetic diffusion, providing prolonged afferent blockade and excellent surgical analgesia in both the inpatient and outpatient setting. Furthermore, thoracic epidural is associated with risks of neurologic damage, postural hypotension, and urinary retention.[12]

Paravertebral blockade in conjunction with sedation provided adequate anesthesia for the vast majority of patients in our series with low rates of conversion to general anesthesia and low requirements for supplementation with local anesthesia. Only 12% of inpatients undergoing paravertebral block required immediate analgesic medication compared with 80% of patients undergoing general anesthetic. Twenty-five percent of paravertebral block patients ultimately required inpatient narcotic analgesic during their hospital stay. These findings are consistent with the prolonged (average 23 hour) sensory block described in our initial series of patients undergoing paravertebral block, and the patients' description of stiffness — as opposed to actual pain — as the block resolves and sensation returns at the operative site.[17] There was a significantly lower incidence of nausea and vomiting warranting therapeutic intervention in the paravertebral group. While the experience of ambulatory patients was not measured, almost certainly decreased pain, nausea, and vomiting contributed to the significantly greater incidence of early discharge of patients after paravertebral block relative to general anesthesia. The incidence, severity, and duration of pain, nausea, and vomiting after discharge are of the utmost importance in assessing outcome and determining the value of paravertebral block. These, quality of life during recovery, and patient satisfaction will be prospectively measured in an upcoming study randomizing patients undergoing breast cancer surgery to general anesthesia *versus* paravertebral block.

The ability to perform breast cancer surgery under regional anesthesia as an ambulatory procedure has the potential for major cost saving. A recent study demonstrated 75% to 78% cost reductions in patients undergoing ambulatory breast cancer surgery as opposed to surgery followed by a 2 to 3 day hospitalization.[34] In our institution, same day discharge after paravertebral block, as opposed to a single overnight hospital stay, resulted in cost savings of more than $800 per patient (22% of total costs) because of elimination of hospital room charges and reduction of pharmacy and supply charges.[17] Furthermore, the technique of paravertebral block does not increase costs by prolonging operating room occupancy time or requiring expensive equipment or pharmaceuticals. Consideration of such cost savings would be meaningless if ambulatory discharge after breast cancer surgery were not appropriate or conducive to the emotional well-being of the patient. Both our experience and others have shown that returning home early to familiar surroundings and avoiding hospitalization result in a greater degree of satisfaction, a sense of patient control over the disease process, quicker recovery without assumption of a maladaptive sick role, and strengthened relationships between the patient and her family during the recovery interval.[17,34]

The efficacy and safety of paravertebral block for operative

treatment of breast cancer confirm Richardson's assertion that this technique "should be considered as the afferent block of choice for unilateral surgery of the chest or trunk and is the 'gold standard' by which all other forms of afferent block should be compared."[12] In the current climate of cost containment and managed care delivery, the shorter hospital stay experienced by patients undergoing paravertebral block will result in significant cost savings nationwide. Most importantly, by reducing nausea, vomiting, and surgical pain, paravertebral block markedly improves the quality of operative recovery for patients who are treated for breast cancer and therefore provides the patient with the choice to return home as early as desired after surgery.

Acknowledgements

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